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ABSTRACT

One of the working papers in the final report of the Arizona Board of Regents' Task Force on Excellence, Efficiency and Competitiveness, this study focuses on Arizona's university research and economic development. There is concern that America is losing its competitive edge in the crucial areas of science and technology as fewer students study engineering, science, and mathematics. As incentives for industrial research and development diminish, the potential role of university conducted research is enlarged. Research costs and benefits are discussed, noting that the extent to which a university engages in research is widely recognized as an index of its excellence. Arizona's changing research climate is explained. Arizona faculty members are encouraged more directly now in entrepreneurial activities based on research. Cautionary concerns and potential dangers are emphasized, since, although emphasis on economic development and technological competitiveness is appropriate and crucial, it can produce a skewed conception of university research. A case study in cooperative innovation is presented (the SEMATECH microchip research consortium). Six recommendations include: the Board of Regents should continue to encourage technology transfer via policies that lower or remove barriers; the state should institute a program of matching grants for research projects with potential economic benefit; and cities and the state should work together to support schools of very high quality and the various amenities that make Arizona a desirable place to live and work. Contains 10 references. (SM)

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UNIVERSITY RESEARCH AND ECONOMIC DEVELOPMENT IN ARIZONA TODAY: A WORKING PAPER

MARVIN FISHER

When asked by a skeptic "What is the use of scientific research?" Benjamin Franklin, founder of what came to be the University of Pennsylvania, answered with his own question: "Of what use is a baby?" Franklin was quite willing to support research even when it was not immediately applicable to need, because he viewed it as an investment in the future. But we also know from the availability in the 18th century of such still used items as the lightning rod, bifocal glasses, and the Franklin stove that Dr. Franklin had a keen eye for technological applications and adaptations. He was in a real sense the father of technology transfer in America and viewed the exercise of scientific curiosity as a form of public service or community concern, ultimately as beneficial as his creation of a postal service, a fire department, a public library, or a system of municipal lighting in Philadelphia. Economic development may have been secondary to a materially improved standard of living, but it was already an apparent concern.

By the middle of the 19th century, the excellence and competitiveness of

American attainment in manufacturing and management had become painfully apparent to visitors from abroad. One conservative Englishman summed up his impression of the U.S. this way: "Thus in energy, enterprise, perseverance, sagacity, activity and varied resources... which contribute to produce what is technically called material civilization,... there is no disputing the superiority of the Americans to ourselves. Wherever they have a fair play, whether in the management of a hotel, of a ship, or a prison, or a factory, there is no competing with them" (Godley, I, IX-X). On this issue even his most determined liberal opponent had to agree when confronted by "gigantic facts proving the indisputable superiority of that country in all that constitutes the power, wealth and real greatness of a people" (Cobden, 26).

In addition to management efficiency, mid-19th century visitors praised design efficiency in American locomotives, sailing ships and steam navigation, increasing use of interchangeable parts and mass production procedures, conveyor belts in the ceilings of tobacco curing factories, and a disassembly line in a Cincinnati slaughterhouse. Some of the highest praise for efficiency applied to common agricultural tools--forks, rakes, shovels and the like, which "display a lightness combined with

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**RESEARCH AND GRADUATE EDUCATION/
UNIVERSITIES - A STATE RESOURCE**

strength, a beauty of proportion and high finish, which is not seen even in our most improved ones and is far superior indeed to those commonly used here. Their best five-pronged forks are cut out of a single piece of steel, and ... ring like a tuning-fork: lightness and handiness are particularly attended to in these; whereas here [England] it seems to be forgotten that half a pound of superfluous weight lifted only each quarter of a minute makes a difference of at least half a ton in the working day, and lessens...the quantity of work the laborer can perform in the day. It is to be feared, that unless our manufacturers vie with these models they will lose the colonial and foreign markets" (Eddy, 120-21).

It probably was not a historian who first said "What comes around, goes around," but a historian could not find a better phrase to suggest that the U.S. now stands where Great Britain did in the mid-19th century. Japan and West Germany compete effectively in electronics, automobiles, cameras and scientific optics. The VCR was invented in the U.S. 30 years ago, but not one is manufactured here today. Manufacturers of clothing and shoes have either moved to third world countries or draw third world workers to the U.S. Watches at the high and low end of the scale come from elsewhere. Our budget and balance of payments rise like twin towers (or is it twin shafts?). The American computer industry is still running strong, but even here the competition is formidable. Our new tax laws lessen the advantage of deductions for industrial research and development. Japan, with half the population, graduates more engineers than the U.S. Twenty years ago the number of engineers per capita in the U.S. was higher than that of any other country, but as our decline began in the

late 1960's, the proportion of engineers rose steadily in Japan and West Germany. The National Science Foundation projects an even more appalling statistic: even if the U.S. could attract students to science and engineering programs at the 1983 rate, the number of science and engineering graduates would be almost 700,000 fewer over the next 20 years than in the past 20 years. (*America's Competitive Crisis*, 17-18). Mathematics graduates chart a similar trajectory, and at present more doctoral degrees in math go to foreign students in American universities than to American students. Unfortunately, less is not more in this instance; the drop in quantity does not produce a rise in quality; and it is an understatement to suggest that the nation is losing its competitive edge in the crucial areas of science and technology.

RESEARCH COSTS AND BENEFITS

As the incentives for industrial R & D diminish, the potential role of university conducted research is enlarged. At the nation's premier universities the total of research expenditures from federal, corporate, and where applicable, from state sources exceeds the cost of government in some of the lesser members of the United Nations. For a university intent on recruiting a top rung researcher in a hot science field, the salary is insignificant in comparison to laboratory and equipment costs. In the case of state universities, the increasing emphasis on and cost of research activity constitute a target for the criticism of economy-minded legislators and concerned members of the general public. Universities have been pressed to show that heightened research activity does not draw down the level of instructional quality and that direct

economic benefits accrue to community and state from the investment in research.

Many of Arizona's ablest high school graduates choose to continue their education elsewhere. The most gifted overwhelmingly choose universities with strong reputations for research rather than small colleges which emphasize teaching. If questioned about their choices, however, they are very likely to answer in terms stressing their expectations of the quality of education, ignoring the institution's reputation for research excellence. Published rankings of our universities, whether based on federal grants or reputational impressions, are more openly based on quality and quantity of research activity.

The extent to which a university engages in research is widely recognized as an index of its excellence. The record of its ability to foster the transfer of discovery, improved process, or new technology into a more utilitarian sector is one measure of its efficiency. The effect of that transfer on the economy of locality and state adds to the competitiveness of the institution and the state. Viewed as a whole, the movement of university sponsored or affiliated research into the productive sector combines the delight of discovery with the prospective profitability of industrial and commercial application. The potential impact on economic development, from the creation of new jobs to a broader tax base, can effectively unite research and public service and fulfill two traditional aspects of a university's mission in a dramatic new way. The dollar impact of a major university research program on the local economy is difficult to calculate, but an estimate offered by Dr. Laurel Wilkening, UA Vice President for Research, and based on studies of the

UA Division of Economic and Business Research, suggests that a \$100,000,000 research budget could have an economic impact of \$228,000,000 on the local community.

The role of the university as an agency abetting economic development through discovery and promotion of new products and processes has an impressive history in the United States. The Morrill Act in 1862 established land grant colleges to spur economic development in agriculture, commerce and industry. The Hatch Act of 1887 furthered these purposes by providing outside funding for agricultural research and services. Under the Hatch Act, UA qualified for its first federal grant of \$10,000 in 1890, followed by an additional \$30,000 commitment under a second Morrill Act later in 1890. Many of these land grant institutions have become the major public research universities of today. Their potential role in fostering economic development is even greater, but the means of doing so are more complex than the establishment of agricultural or engineering experiment centers. Contemporary efforts to strengthen the higher education-economic development connection increasingly depend on innovative linkages of the public and private sectors--arrangements involving not only representatives of universities and industry but also agents and agencies of city and state government and the services of highly specialized for-profit or non-profit research development and marketing corporations.

ARIZONA'S CHANGING RESEARCH CLIMATE

The day of Arizona's reliance on copper, cotton, citrus and cattle has passed. Climate and construction and more

recently components and computers have superseded the first combination, and the new combination is transforming Arizona's major population centers into examples of post-industrial society. The most important factor in this transformation and in Arizona's continuing economic health has been the growth of manufacturing, not the relocation of existing industry but the development of new firms and their subsequent expansion. Whereas mining and heavy industry (smokestack industries) required access to power and rail lines, a supply of relatively unskilled labor, and sources of natural or processed resources, today's high technology industries do not have to locate on navigable rivers or near rail lines. They are more concerned with locating near a major research university that can supply the specialized knowledge, state-of-the-art computers, and access to relevant graduate programs for continuing professional development. These universities are the hub of a knowledge-intensive society and the most important resources for attracting a future-oriented, "sunrise" industry or industrial consortium.

The experience of many states demonstrates that regional economic growth can be significantly stimulated by the technological offshoots of academic research, but in Arizona state investment in economic development has lagged behind the leaders. Silicon Valley, Route 128, and the Research Triangle are metaphors of economic geography, easily grasped by informed readers. For universities these localities constitute patterns for potentially beneficial cooperation with firms on the cutting edge of contemporary technology and opportunities for encouraging faculty entrepreneurship. Universities can use income from licensing costs to defray the

fearfully high start-up costs for active, new researchers. Graduate students can gain practical experience in situations that universities cannot duplicate and with equipment that few universities can afford.

With its involvement in applied research dating back to the Hatch Act and the second Morrill Act in the late 19th century, UA leads the Arizona universities in creating the mechanisms and atmosphere conducive to technology transfer and economic development. These activities are centered in the Office of Technology Transfer (OTT) and the Arizona Technology Development Corporation (ATDC).

With greater latitude resulting from recent amending of Arizona's conflict-of-interest law, and a new patents policy, Arizona faculty members are encouraged to engage more directly in entrepreneurial activities based on their research. The Arizona Technology Development Corporation, organized "as a for-profit arm of the University of Arizona Foundation," exists to enable faculty researchers to benefit more directly from their efforts and to speed new technology into commercial application. According to a recent but undated UA publication entitled The Value of Research at the University of Arizona, the services of ATDC "could include handling patenting matters, generating venture capital, creating new companies, or forming joint ventures or licensing arrangements with existing companies." (p.4). ATDC, with its private corporate status and indirect link to the UA, has given rise to a more recent entity funded by the UA and called the Office of Technology Transfer. Its functions would precede those of ATDC, giving ATDC the more specific

responsibility of developing viable commercial enterprises.

The University has also entered into a cooperative program for commercial transfer of new inventions, new plant species, and related cultivars. The new patent management/technology transfer partner is Research Corporation Technologies (RCT), a subordinate spin-off of the 76 year old Research Corporation. Founded for the purpose of funding scientifically significant research, the Research Corporation is based in Tucson, maintains international operations, and is directed by a former UA president and a former vice president.

RCT thus provides OTT with many strengths and capabilities for licensing invention disclosures that cannot be matched by in-house patent management agencies. Nevertheless, ATDC will remain an alternative means of commercializing technological innovation through nurturing new companies. To date, six companies have been launched, and ATDC holds an equity position in each on behalf of the University. ATDC supplied early aid and guidance through funding and planning and continuing aid and advice through placing an ATDC officer on each company board.

A look at the economic impact of one conspicuously successful UA unit devoted to both teaching and research in optical sciences provides some illuminating results. A national leader in the field, the Optical Sciences Center currently attracts contracts and grants totaling nearly \$10,000,000 a year. Since its inception in 1968, OSC has received almost \$10,000,000 in state funds but attracted nearly \$90,000,000 in outside funds. During the ten-year period from

1973 to 1983 state funding amounted to \$4,317,000, but the total cash flow generated by the Center was more than ten times the state funding. If 50% of the total cash flow went for salaries and wages and 25% of the remainder went for goods and services within the state, the state investment of \$4.3 million produced a \$27 million infusion into the state economy.

Arizona State University, despite its location in the state's population center, has had a later start in pursuit of economic development. The Phoenix Economic Development Corporation seems to have been unaware of the potential role that ASU could play in research and economic development until the last-minute SEMATECH proposal was put together. It is evident that ASU's College of Engineering began a major transformation from a "nuts and bolts" operation to a stage of major aspiration and achievement with its Engineering Excellence Program in 1979, and it has taken time for full awareness to permeate community consciousness.

The Phoenix-based Arizona Focus on Technology and the Arizona Innovation Network have prepared detailed recommendations constituting "a legislative agenda on economic development," calling for a variety of State-University-Industry-Business linkages, and discussing possible sources of venture capital (including the possibility of tapping into state pension and retirement funds), but these are not yet organizations with established legislative influence. Arizona State University has created the Arizona State Research Institute, a non-profit corporation, in pursuit of many of the same goals as the ATDC, and shortly thereafter entered its first major technology transfer agreement with a

private firm interested in marketing a blood-sugar sensor to be used with an insulin pump. Although both of these technology transfer agencies have been incorporated with the state, only ATDC has thus far achieved a memorandum of understanding with the Board of Regents regarding its precise relationship to the university.

Just as the contemporary research university, despite its frequently urban location, has its ideological roots in the stated mission of the land grant institutions, the language used to convey its new role in economic development draws heavily on the agrarian experience of the past. One university administrator in a midwestern state made little headway with a legislature that was skeptical about the time and money going into research and fearful that teaching was being neglected--until he pointed out that research was the fertilizer that made economic development grow. Through the metaphors of the new alliance of business, industry, and academia, the myths that invested our past assume a new currency and spokesmen who never raised a crop explain the need for seed money and the role of incubators in producing home-grown technology. Logic tells us that Ben Franklin could not possibly have foreseen this when he implied that we needed to nurture science and technology just as we nurtured an infant, that each was an investment in the future. But intuition links Franklin's practical idealism and the contemporary efforts of Pennsylvania's Ben Franklin Partnership, one of the nation's most successful providers of seed money through its four advanced technology centers, which also serve as incubation facilities where research grows into new technology. The consortium of business, industry, labor,

local economic districts and academic institutions constitutes the largest state technology program in the country, and its record of successful technology development and transfer makes it an enviable model for a host of would-be emulators.

When the first ASU Farm gave way to a new president's residence and moved its operations beyond the city limits, only to find the city surrounding the new location in just 20 years, it again gave way to social change and began metamorphosis into the ASU Research Park. Integrated with the first phase of ASU's Engineering Excellence Program (1979-1984) the Research Park was planned with several functions and goals: providing incubator facilities, attracting industrial affiliates and encouraging cooperative research, speeding technology transfer, and creating new jobs and an increased tax base. The completion of the five-story, 120,000 square foot Engineering Research Center in 1984 and the 1987 commitment of ICI Americas for major research facilities should enhance the attractiveness of the Research Park for future tenants. The establishment of a Center for Professional Development in Engineering in 1981 emphasized human resource development through the creation of new credit and non-credit courses for local engineers and computer scientists. It could also help persuade new industry to locate where their technical employees could upgrade their skills and develop new competencies. And in dramatic contrast to the threat of a national decline in engineering enrollment, ASU's enrollment in engineering has increased 100% during the past six years. Research awards have shown an even greater rise: from \$1.64 million in 1980 to more than \$14 million in 1986. The first

phase seems to have earned good grades for attaining most of its objectives.

Phase II of the Engineering Excellence Program (1985-1990) adds the new area of Telecommunications to the earlier focus on Solid State Electronics, Computer Science, Computer Aided Processes, Energy Systems, Transportation Systems and Thermosciences. In pursuit of organized research in these targeted research areas, Phase II illustrates an economic consequence of developing research excellence: dependence on legislative funding will be more than halved, federal funding should double, and the industrial contribution should also increase. And as in the case of the Optical Sciences Center, the economic return to the state will be several times the state investment for the five-year period.

The ASU College of Business has also launched an incubator project under the umbrella of the Hahn Center for Entrepreneurship and Innovation and in conjunction with the College of Engineering and the ASU Foundation. Funded by local business operators and a small number of corporations, the new facility will serve as a laboratory providing hands-on and heads-up business involvement for faculty and students; low rent and shared support services, as well as seed money for new companies; and development services in such areas as further financing, purchasing and marketing. The College of Business will have equity interest in the developing companies, and the corporate partners and the individual limited partners will share in the proceeds when the incubator liquidates its holdings in the successful companies.

The research climate at NAU has also changed in the past decade. While recently reported research into the genetics of flowering plants can significantly affect grain production and the food supply, or research into forest management and replenishment has both environmental and economic implications, or hospitality research can tie directly to the development of the tourist industry, some of the most important interdisciplinary research into the physical and cultural aspects of the Colorado plateau has less immediate economic impact but no less scientific or human significance. In fact the College of Engineering project to equip isolated Indian homes with electrical power generating solar cells constitutes technology transfer of a highly admirable and unusual sort. NAU's growing emphasis on research may be far from UA's achievement or ASU's potentiality as an urban-based developing research university, but it is clearly in a take-off stage and has already added new dimensions to the institution's stated mission and new facets to its past character.

CAUTIONARY CONCERNS AND POTENTIAL DANGERS

Emphasis on economic development and technological competitiveness is both highly appropriate and crucial at the present time, but it can also produce a skewed or inadequate conception of university research, much of which may have significant literary, historical, artistic or broadly cultural importance, without direct economic benefit. A monetary standard is only one measure of a research university's achievement, material goods only one measure of a standard of living or quality of life. An excellent university will demonstrate a balanced excellence and constitute a

vitalizing force that affects a community in ways more profound and complex than its contribution to the local economy alone. Economic development is but a means to higher ends, and our universities fulfill their potential excellence by pursuing those means without neglecting those ends. Some faculty are determined to block university research that might have military applications or that includes a proprietary interest; some administrators evaluate a faculty member not only in terms of grant money secured but also in terms of overhead funds generated by the grant. Both extremes indicate a limited understanding of the complex mission and character of the contemporary, state-supported research university. Conflicts can arise from academic-industrial linkages, and faculty peer evaluation procedures can lead to thorny disagreements over tenure and promotion, unless traditional criteria are modified or expanded. Disagreements over the public availability of university conducted research have already arisen. Some faculty members have objected to industry's proprietary need for competitive advantage and argue that industry imposed restrictions compromise academic freedom. These dangers are real, but they are not inevitable and should not obviate the far-reaching advantages of an administrative strategy for maximizing economic development. (Table 1 summarizes the variety of university roles in economic development, the forms it may take, potential benefits, and potential concerns.)

SEMATECH: A CASE-STUDY IN COOPERATIVE INNOVATION

In a complex, highly innovative and admirably cooperative attempt to

convince SEMATECH, a major microchip research consortium, that Phoenix was the best site for the consortium's national headquarters, representatives of the city, the state, the non-profit Phoenix Economic Growth Corporation, the Board of Regents and the universities joined in an effort of major significance. The 13 companies joined in the SEMATECH consortium (IBM, Digital Equipment, Hewlett-Packard, AT & T, Motorola, Texas Instruments, Rockwell International, Advance Micro Devices, National Semiconductor, LSI Logic, Micron Technology, Intel, and Harris Semiconductor) aim to restore American leadership in microchip manufacturing and related computer technology. Their goal is not merely to regain a competitive position but to regain a leadership position. The success of the Arizona bid would confirm state, city and university competitiveness, but the mere existence of this innovative proposal goes a long way in suggesting the character of Arizona's growing competitive spirit.

Leading off with the Governor's letter of general endorsement, the proposal becomes more specific with Mayor Goddard's pledge to:

1. Provide the SGS Semi-Conductor facility on a 30-year lease basis, with option to purchase commencing in the tenth year and with rental participation by the City of Phoenix and the ABOR in the amount of \$18,750,000;¹
2. Exempt SEMATECH from paying an estimated \$15 million in ad valorem taxes on land and building over a 10-year period;
3. Exempt SEMATECH from paying \$210,000 in city development

fees.

Private sector benefits cited in the mayor's letter would:

1. Save SEMATECH at least \$2 million in electric utility costs over 10 years;
2. Save SEMATECH at least \$5.6 million in employee relocation costs;
3. Save SEMATECH \$2.35 million in future land expansion costs.

The President-Elect of the Arizona Board of Regents calls attention to further aspects of the cooperative proposal and conveys the Board's intention to:

1. Designate the SGS Semi-Conductor facility as a university research park, gaining for SEMATECH significant property tax advantages;
2. Allocate \$1.5 million a year for 10 years from appropriated funds;
3. Provide university cooperation, technical support and use of facilities and equipment amounting to approximately \$158 million over 10 years.

The Phoenix Economic Growth Corporation would issue nearly \$70 million in taxable bonds to buy the presently vacant SGS Semi-Conductor facility, which would ultimately be leased to SEMATECH. But before that could be done, PEGC would sell the plant on a 10-year contract to the city, which would resell the property and transfer the title to the Board of Regents, so it could be declared a university research park before being turned over to Phoenix for lease to SEMATECH. The figure of \$18,750,00 cited in Mayor Goddard's letter is a compound of the \$1.5 million a

year pledged by the ABOR for a 10-year period and the \$750,000 a year pledged by the City of Phoenix over a 5-year period.² The city expects to gain approximately \$1 million a year in excise taxes. The benefits to the ABOR may be less tangible, but ultimately more significant through potential effects on university research estimated at \$6 to \$20 million annually in contracts. The greatest impact, of course, would be on the local economy and on the economic profile of the state.

In addition to the majority of participants, numerous local businesses have offered additional incentives to SEMATECH and its employees. Arizona Public Service, through its Economic Development Rate Incentive Program, has offered discounted rates that could amount to several million dollars in savings over a five year period and double that over a ten year period. American Continental Corporation has agreed to offer 1250 room nights at the Crescent Hotel at approximately half the standard rate for suites and rooms. America West Airlines would offer 250 round-trip tickets at the cost of one-way fares to Chicago, New York and Washington as well as to its western locations. United Van Lines' Phoenix operator, Horizon Moving Systems, would offer substantially reduced moving rates and storage charges. Founders' Title Insurance Company would offer significant savings on insurance premiums and escrow fees. Six local home builders would offer discounts on new homes to SEMATECH employees and several major banks would forego their standard one percent loan origination fee and reduce their rates for fixed and adjustable rate mortgages.

THE SPECTRUM OF COLLEGE AND UNIVERSITY ROLES IN ECONOMIC DEVELOPMENT

ECONOMIC OBJECTIVE	COLLEGE AND UNIVERSITY ROLES	EXAMPLES	POSSIBLE ECONOMIC BENEFITS	POSSIBLE INSTITUTIONAL BENEFIT	SOME POTENTIAL CONCERNS
Economic research and analysis	Economic data gathering Economic base analysis Industry analysis Strategy development	Cleveland State College of Urban Affrs Eastern Oregon State Regional Services Inst	Better information Improved decisions Effective strategies	Public service mission Community image Student opportunities	Needs not well understood Government/academia conflicts Involvement in local politics Work seen as too academic
Capacity building	Training Technical assistance Building partnerships	U. of Colorado-Denver P/P Center Western Carolina WNCI Tri-State Conference	New local capacity New partnerships	Public service activity Community support Taps faculty skills	Lack of ties to community groups Needs not well understood Involvement in local politics Work seen as too academic
Human resources development	New education programs Continuing education Professional development Extension program	Arizona State Center for Eng Exclnce George Mason Institute of Science & Tech	Skilled workers Means of up-dating Lifelong learning	New students New programs Revitalized curricula Increased responsiveness	Misreading labor market Vocational orientation Inflexible programs Need to cut some programs
Technical assistance	Small bus devt centers Productivity centers Industrial extension Faculty consulting	Georgia Tech Industrial Extension U. of Alabama/GM UT-San Antonio CED	Aid to new and small business Knowledge of mgt. and eng. tools	New business support Research opportunities Consulting opportunities Student experiences	Drain on faculty time Not seen as prestigious Faculty resistance Lack of special resources
Research	Centers of excellence Research consortia Cooperative research Industrial affiliates	U. of Akron EPIC U. of Cal MICRO Michigan State Biotech Center	Technical edge New production processes New products and services	National visibility New research revenues Understanding of needs Access to labs, equipt	Politicization of research Conflicts of interest Threats to academic freedom Economic pay-offs are long-term Undergrad education may be hurt
Technology transfer	Tech transfer program Shared equipt/facilities Faculty consulting Sabbaticals	Ben Franklin Partnership Washington Research Foundation Michigan Industrial Technology Institute	Access to technology	New revenues (royalties) Feedback to classroom Student learning Taps technology base	Lack of industry linkages Faculty resistance Competition with private firms Lack of organizational vehicle Academic/industry conflicts
New business development	Incubators Research park Financing program Entrepreneurship	Utah Innovation Center Texas A&M INVENT Ohio University	New start-up firms New jobs Increased tax base	New revenues (equity) Faculty income Improved industry ties	Lack of strong research base Requires supportive services Restrictive regulations Detracting from teaching roles Replicating inappropriate models

From The Higher Education - Economic Development Connection, SRI International, 1986, p.25.

The extent of cooperative effort between the public and the private sector in fashioning this proposal demonstrates the growing realization of what it takes to be competitive in attracting new high-tech industry. Only a few months ago U.S. West's \$50 million dollar research laboratory went to Colorado because, as a company spokesman put it, "research being done at both the University of Colorado and Colorado State University was the best match for our business needs" (*The Phoenix Gazette*, October 24, 1987, A-6). The quality and the specific focus of university research apparently swung this decision, but certainly the educational opportunities and the cultural amenities provided by the universities were also factors. Where industries once looked for available cheap labor in location decisions, they now look for available, adequately trained labor or for advanced educational facilities where their employees may develop requisite new skills. They look also for a public school system that can more than adequately prepare children for the kind of higher education they will need in the future. In a relationship of dynamic reciprocity, the competitiveness of a state depends increasingly on the excellence of its universities and of the schools that feed into them. Good business sense would recognize the need to maintain a sound level of investment for a variety of reasons, including the spur to economic development that major research universities now provide.

But the universities cannot effect such potential economic benefits without extensive local and state cooperation. Local economic development corporations, in conjunction with an appropriate state agency, the Board of Regents, and of course the Governor and the Legislature, can fashion an

economic climate as important as the physical climate. The transformation of the state Office of Economic Planning and Development (OEPAD) into the Department of Commerce signaled a more aggressive and comprehensive strategy, but we do not yet have much to show for it. We need to regain momentum at the state level. The Board of Regents can continue to encourage technology transfer policies that remove existing barriers. The State of Arizona could institute a new program of matching grants for research projects of potential economic benefit, whereby every dollar of state funding had to be matched by two or three dollars from federal and corporate sources. Such a program should not be lodged in the Board or the universities but in a new agency, perhaps in an existing state department, to indicate that its purpose is economic development, not additional state support for higher education. Such economic leveraging could greatly affect research focused on Arizona interests.

A companion program lodged in the same agency could provide the seed money that would enable innovative enterprises to attract venture capital from private investors. One source of support in many states is a small percentage of the state pension funds; another could be a small percentage of lottery receipts.

These efforts must be coupled also with efforts to improve the cultural climate: creating and maintaining a school system of conspicuously high quality, supporting the institutions and activities that serve aesthetic and humanistic needs, preserving an attractive and healthful physical environment, and providing the public services essential to a contemporary, civilized society.

RECOMMENDATIONS

- o The Governor, the Legislature, the Board of Regents, the universities, and local economic development agencies need to develop more effective cooperation and coordination in an effort to attract new industry and encourage home-grown efforts.
- o The Board of Regents should continue to encourage technology transfer through policies that lower or remove existing barriers.
- o The state should institute a program of matching grants for research projects with potential economic benefit, requiring that every dollar of state funding be matched by two or three from federal or corporate sources.
- o The state should also create a companion program to provide seed money to enable innovative, new businesses to attract venture capital from private sources. A small percentage of state pension funds or lottery receipts (or both) could finance this program.
- o Both of the preceding programs should be housed in an agency separate from the Board of Regents or the universities to indicate that the purpose is economic development, not increased aid to higher education.
- o Cities and the state should work together to support schools of conspicuously high quality and the social, cultural, physical, and aesthetic amenities that make Arizona a desirable place to live and work.

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ENDNOTES

1. Subsequently raised to \$22,500,000.
2. Subsequently raised to \$1,000,000 a year over a 6-year period.